IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Jae Hyun Lee.	)
		) Group Art Unit: 1795
Serial No.:	10/552,529	)
		)
Filed:	October 11, 2005	)
		) Examiner: ARICERO,
		) Adam A.
For:	CATHODE ACTIVE MATERIAL COMPRISING ADDITIVE FOR IMPROVING OVERDISCHARGE-PERFORMANCE AND LITHIUM SECONDARY BATTERY USING THE SAME	)
		)
		) Confirmation No. 6682
		)
		)

VIA EFS
Commissioner for Patents
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AMENDMENT AND RESPONSE

Sir:

This amendment is submitted in response to the Final Office Action dated April 13, 2009. A request for continued examination under 37 C.F.R. 1.114, and a petition for extension of time for one month, from July 13, 2009 to August 13, 2009, also accompany this amendment.

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 6 of this paper.

Please amend the Application as follows:

IN THE CLAIMS

1. (Currently amended) A cathode active material for a lithium secondary cell comprising:

a first lithium[[-]] transition metal oxide capable of lithium ion intercalation/ deintercalation, and

~~characterized by further comprising~~ a second lithium ~~-manganese-~~ transition metal oxide capable of lithium ion intercalation/ deintercalation, the second lithium transition metal oxide ~~having a higher irreversible capacity than the lithium transition metal oxide and~~ having a layered structure, and represented by ~~the following~~ formula 1 ~~as an additive~~:

[formula 1]

$LiM_xMn_{1-x}O_2$

wherein, x is a number satisfying $0.05 \leq x < 0.5$, and M is at least one metal selected from the group consisting of Cr, Al, Mn and Co,

the second lithium transition metal oxide undergoes a structural change on the first charge from a layered material to a material having a spinel structure, and

the second lithium transition metal oxide has an irreversible capacity of 0.5 mole of lithium per two oxygen atoms on the first charge.

2. (Currently Amended) The cathode active material according to claim 1, wherein the content of the second lithium transition metal ~~-manganese-~~ oxide ~~having a higher irreversible capacity than the lithium transition metal oxide and having a layered structure~~ is 1 to 50 parts by weight, based on 100 parts by weight of the first lithium -transition metal oxide.

3. (Currently Amended) The cathode active material according to claim 1, wherein the second lithium transition metal ~~manganese~~ oxide ~~having a higher irreversible capacity than the lithium transition metal oxide and having a layered structure~~ is $LiCr_{0.1}Mn_{0.9}O_2$.

4. (Currently Amended) The cathode active material according to claim 1, wherein the first lithium transition metal oxide is at least one material selected from the group consisting of:

$LiCoO_2$, $LiNiO_2$, $LiMnO_2$, $LiMn_2O_4$, $Li(Ni_aCo_bMn_c)O_2$, $LiNi_{1-d}Co_dO_2$, $LiCo_{1-d}Mn_dO_2$, $LiNi_{1-d}Mn_dO_2$, $Li(Ni_xCo_yMn_z)O_4$, $LiMn_{2-n}Ni_nO_4$, $LiMn_{2-n}Co_nO_4$, $LiCoPO_4$ and $LiFePO_4$, wherein $0<a<1$, $0<b<1$, $0<c<1$, $a+b+c=1$, $0\leq d<1$, $0<x<2$, $0<y<2$, $0<z<2$, $x+y+z=2$, and $0<n<2$.

5. (Currently Amended) A lithium secondary cell comprising a cathode, an anode, a separator, and a non-aqueous electrolyte solution containing a lithium salt and an electrolyte compound, wherein the cathode comprises a cathode active material comprising

a first lithium[[-]] transition metal oxide capable of lithium ion intercalation/ deintercalation, and

a second lithium ~~manganese~~ transition metal oxide ~~having a higher irreversible capacity than the lithium transition metal oxide~~ capable of lithium ion intercalation/ deintercalation, the second lithium transition metal oxide ~~and~~ having a layered structure, and represented by ~~the following~~ formula 1 ~~as an additive~~:

[formula 1]

$LiM_xMn_{1-x}O_2$

wherein, x is a number satisfying $0.05\leq x<0.5$, and M is at least one metal selected from the group consisting of Cr, Al, Mn and Co,

the second lithium transition metal oxide undergoes a structural change on the first charge from a layered material to a material having a spinel structure, and

the second lithium transition metal oxide has an irreversible capacity of 0.5 mole of lithium on the first charge.

6. (Currently Amended) The lithium secondary cell according to claim 5, wherein the second lithium ~~manganese~~ tranition metal oxide ~~having a higher irreversible capacity than the lithium-transition metal oxide and having a layered structure represented by the following formula 1, which is contained in the cathode active material,~~ is changed into a lithium manganese oxide ~~having a spinel structure~~ represented by ~~the following~~ formula 2 ~~by~~ on the first charge/discharge cycle of the lithium secondary cell:

[formula 1]

$LiM_xMn_{1-x}O_2$

[formula 2]

$LiM_{2x}Mn_{2-2x}O_4$

wherein, x is a number satisfying $0.05 \leq x < 0.5$, and M is at least one metal selected from the group consisting of Cr, Al, Mn and Co.

7. (Original) The lithium secondary cell according to claim 5, wherein the lithium salt is at least one selected from the group consisting of $LiClO_4$, $LiCF_3SO_3$, $LiPF_6$, $LiBF_4$, $LiAsF_6$ and $LiN(CF_3SO_2)_2$, and the electrolyte compound is at least one carbonate selected from the group consisting of ethylene carbonate (EC), propylene carbonate (PC), gamma-butyrolactone (GBL), diethyl carbonate (DEC), dimethyl carbonate (DMC), ethylmethyl carbonate (EMC) and methylpropyl carbonate (MPC).

8. (Currently Amended) The lithium secondary cell according to claim 5, wherein the content of the second lithium ~~manganese~~ tranition metal oxide ~~having a higher irreversible capacity than the lithium-transition metal oxide having a layered structure~~ is 1 to 50 parts by weight, based on 100 parts by weight of the first lithium[[-]] transition metal oxide.

9. (Currently Amended) The lithium secondary cell according to claim 5, wherein the second lithium ~~manganese~~ transition metal oxide ~~having a higher irreversible capacity than the lithium-transition metal oxide and having a layered structure~~ is $LiCr_{0.1}Mn_{0.9}O_2$.

10. (Currently Amended) The lithium secondary cell according to claim 5, wherein the first lithium transition metal oxide is at least one material selected from the group consisting of:

$LiCoO_2$, $LiNiO_2$, $LiMnO_2$, $LiMn_2O_4$, $Li(Ni_aCo_bMn_c)O_2$, $LiNi_{1-d}Co_dO_2$, $LiCo_{1-d}Mn_dO_2$, $LiNi_{1-d}Mn_dO_2$, $Li(Ni_xCo_yMn_z)O_4$, $LiMn_{2-n}Ni_nO_4$, $LiMn_{2-n}Co_nO_4$, $LiCoPO_4$ and $LiFePO_4$, wherein $0<a<1$, $0<b<1$, $0<c<1$, $a+b+c=1$, $0\leq d<1$, $0<x<2$, $0<y<2$, $0<z<2$, $x+y+z=2$, and $0<n<2$.

REMARKS

The above amendments are made in response to the Final Office Action of April 13, 2009. Claims 1-10 are pending in the present Application. Claims 1-6 and 8-10 has been amended, and no claims have been added, leaving Claims 1-10 for consideration upon entry of the present Amendment.

A request for continued examination under 37 C.F.R. 1.114 accompanies this amendment.

Applicants respectfully request entry of the Amendment, reconsideration and allowance of the claims in view of the above amendments and the following remarks.

Amendments to the Claims

Claims 1 and 5 have been amended to recite, *inter alia*, "the second lithium transition metal oxide undergoes a structural change on the first charge from a layered material to a material having a spinel structure," supported at least by claim 6 and throughout the specification. Claims 1 and 5 have also been amended to recite, *inter alia*, "the second lithium transition metal oxide has an irreversible capacity of 0.5 mole of lithium on the first charge," supported at least in the specification on page 7, lines 13-15 which recites that the lithium manganese oxide of formula 1 deintercalates 1 mole of lithium per two oxygen atoms during the first charge and becomes a substance able to intercalate/deintercalate 0.5 moles of lithium per two oxygen atoms. Therefore one of ordinary skill in the art would understand that the lithium manganese oxide has an irreversible capacity of 0.5 moles of lithium per two oxygen atoms.

Claims 1-6 and 8-10 have been further amended for proper antecedent basis, consistency and clarity.

Claim Rejections under 35 U.S.C. § 112, Second Paragraph

Claims 1-10 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. In particular, the Examiner indicates that the claims recite "wherein the lithium manganese oxide has a higher irreversible capacity than the lithum-

tranition metal oxide" and that the specification does not relate the irreversible capacity of the lithium manganese oxide to that of the lithum tranition metal oxide. (Detailed Action dated April 13, 2009, p. 3)

The limitation cited by the Examiner has been deleted and the claims have been amended to recite a first lithium transition metal oxide and a second lithum transition metal oxide. Accordingly, reconsideration and withdrawal of the rejection of claims 1-10 under 35 U.S.C. § 112 and allowance of the instant claims are respectfully requested.

Claim Rejections under 35 U.S.C. § 103(a)

Claims 1-10 stand rejected under 35 U.S.C. § 103(a), as being allegedly unpatentable over Japanese Patent Publication No. JP 2002-100357 to Manabu et al (hereinafter "Manabu") and U.S. Patent No. 5,609,875 to Hasegawa et al. (hereinafter "Hasegawa"). The Examiner states that Manabu discloses a lithium secondary battery comprising a positive active material comprising Li_xCoO_2, where $0.9 \leq x \leq 1.1$ and a lithium manganese oxide represented by $Li_xNi_yMn_{1-y-z}M_zO_2$, where $0.40 \leq y \leq 0.60$, $0.9 \leq x \leq 1.2$, and $0 \leq z \leq 0.2$. (Detailed Action dated April 13, 2009, p. 3-4) The Examiner admits that Manabu does not expressly disclose wherein the lithium manganese oxide is represented by $LiM_xMn_{1-x}O_2$, states that Hasegawa teaches $Li_xA_{1-y}M_yO_2$, and that it would have been obvious to substitute one active material for another. Applicants respectfully traverse this rejection for at least the following reasons.

For an obviousness rejection to be proper, the Examiner is expected to meet the burden of establishing why the differences between the prior art and that claimed would have been obvious. (MPEP 2141(III)) "A patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *KSR Int'l Co. v. Teleflex Inc.,* 127 S.Ct. 1727, 1741 (2007). To find obviousness, the Examiner must "identify a reason that would have prompted a person of ordinary skill in the art in the relevant field to combine the elements in the way the claimed new invention does." *Id.*

The Applicants note that conventional lithium secondary cells are anode limited and disclose a cell in which cell discharge is cathode limited. (p. 2, lines 17-18 and p. 3, lines 19) The Applicants thus disclose a cathode material, and a lithium secondary cell comprising the

cathode material, comprising two lithium transition metal oxides. The second lithium transition metal oxide deintercalates one mole of lithium per two oxygen atoms on the first charge and undergoes a structural change from a layered material to a material having a spinel structure. (p. 7, lines 14-17) Subsequent to the first charge the material has a reversible capacity of 0.5 mole of lithium per two oxygen atoms. (p. 7, line 19) The irreversible capacity provides lithium ions for SEI formation ***and*** the cathode material inhibits capacity loss caused by over-discharge by preventing an increase in anode voltage. (p. 6, lines 25-p. 7, line 28)

Accordingly, independent claims 1 and 5 recite, *inter alia*, the second lithium transition metal oxide undergoes a structural change on the first charge from a layered material to a material having a spinel structure, and the second lithium transition metal oxide has an irreversible capacity of 0.5 mole of lithium per two oxygen atoms on the first charge.

Because Manabu and Hasegawa do not disclose or suggest adding a second lithium transition metal oxide that undergoes a structural change on the first charge from a layered material to a material having a spinel structure, and because one of ordinary skill in the art would have been taught away from adding a material with high irreversible capacity, let alone a material with an irreversible capacity of 0.5 mole of lithium per two moles of oxygen, claims 1 and 5 are non-obvious and thus patentable over Manabu and Hasegawa, alone or in combination.

Manabu states that $LiCoO_2$ and $LiNi_{0.8}Co_{0.2}O_2$ are able to obtain 140-160 mAh/g and 180-200 mAh/g, respectively, over a voltage of 2.5-4.3V. (Manabu, [0004]) Manabu also notes that cells comprising these materials can generate heat and that cobalt and nickel are expensive. (Manabu, [0005]) Manabu states that spinels such as $LiMn_2O_4$ are inexpensive, and cells comprising $LiMn_2O_4$ do not generate heat but capacity is low, 100-120 mAh/g. (Manabu, [0005]) Manabu discloses that adding one atom of Fe, Co, Cr and Al to a lithium nickel manganese multiple oxide provides a mixed metal oxide having improved capacity, safety and durability. (Manabu, [0011]) Manabu does not disclose or suggest a cathode material having structural instability, let alone a material that undergoes a structural change from a layered material to one having a spinel structure, as is recited in independent claims 1 and 5. In addition, Manabu does not disclose or suggest including in a cathode a material a

lithium transition metal oxide having irreversible capacity, let alone a material having an irreversible capacity of 0.5 mole per two moles of oxygen, as is recited in independent claims 1 and 5. Because of the desirability of cells having greater capacity, one of ordinary skill in the art would have been taught away from adding a material having irreversible capacity. Further because Manabu teaches the desirability of high capacity, such as that provided by $LiCoO_2$ and $LiNi_{0.8}Co_{0.2}O_2$, and teaches adding an atom to such a material to improve durability and capacity, one of ordinary skill in the art would have been taught away from adding a material having irreversible capacity and structural instability by Manabu.

Hasegawa does not remedy the deficiencies of Manabu. Hasegawa discloses binders for positive electrodes. (Hasegawa, col. 2, lines 37-53) Hasegawa also discloses a positive active material having the empirical formula $Li_xA_{1-y}M_yO_2$ where A is Mn, Co, or Ni, A is a metal atom including Ni, Cr, V, Fe, Co, Mn, Cu, etc., $0.05 \leq x \leq 1.1$ and $0 \leq x \leq 0.5$. (Hasegawa, Abstract) Accordingly, Hasegawa discloses a method of manufacturing a positive electrode comprising the binder and a lithium metal oxide of the general formula $Li_xA_{1-y}M_yO_2$. Hasegawa does not disclose or suggest a material that undergoes a structural change from a layered material to one having a spinel structure, as is recited in independent claims 1 and 5. In addition, Hasegawa does not disclose or suggest including in a cathode a material having irreversible capacity, let alone a material having an irreversible capacity of 0.5 mole per two moles of oxygen, as is recited in independent claims 1 and 5. Thus Hasegawa does not remedy the deficiencies of Manabu.

Also, in rejecting claim 6, the Examiner alleges that the properties such as the property of changing from a layered to a spinel structure are **inherent**. (Detailed Action dated April 13, 2009) The Examiner further cites *In re Robertson*, and states that the reference is anticipatory if the missing feature *is necessarily present*. (Detailed Action dated April 13, 2009, p. 5)

The theory of inherency is normally reserved for rejections under 35 U.S.C. § 102. *In re Grasseli*, 318 U.S.P.Q. 303 (Fed. Cir. 1983). Furthermore, it is respectfully submitted that the Examiner has inappropriately used the doctrine of inherency in putting forth a rejection under 35 U.S.C. §103 (a). The courts have repeatedly made the distinction that "the inherency of an advantage and its obviousness are entirely different questions. That which

may be inherent is not necessarily known. Obviousness cannot be predicated on what is unknown." *In re Sporrmann*, 150 U.S.P.Q. 449, 452, (CCPA, 1966), citing *In re Adams*, 53 CCPA 996, 356 F.2d 998, 148 U.S.P.Q. 742. "Further it confuses anticipation by inherency, i.e., lack of novelty, with obviousness, which though anticipation is the epitome of obviousness, are separate and distinct concepts." *Jones et al. v. Hardy*, 220 U.S.P.Q. 1021, 1025 (CCPA, 1984) citing *In re Pearson*, 494 F.2d 1399, 181 U.S.P.Q. 641 (CCPA, 1974); *In re Oelrich*, 666 F.2d 578, 212 U.S.P.Q. 323 (CCPA, 1981). "The examiner should be aware that inherency and obviousness are distinct concepts." *Ex parte GPAC Inc.*, 29 U.S.P.Q.2d 1401, 1415, n. 15, *citing In re Naylor*, 369 F.2d 765, 152 U.S.P.Q. 106 (CCPA 1966); *In re Henderson*, 348 F.2d 550, 146 U.S.P.Q. 372 (CCPA 1965).

Furthermore, it is not necessary that the lithiated metal oxides disclosed by Manabu or Hasegawa undergo a structural change upon the first charge. Neither Manabu nor Hasegawa teach structural change upon the first charge. In fact Manabu teaches a material having improved durability. Thus the Applicants respectfully assert that the property of undergoing a structural change upon the first charge is not necessarily present.

The Applicants also maintain that there is no teaching to modify Manabu as suggested by the Examiner, as stated in the Applicants' response dated January 15, 2009.

Manabu discloses a lithium nickel manganese composite oxide ($Li_xNi_yMn_{1-y-z}M_zO_2$) which necessarily contains nickel (i.e., where $0.40 \leq y \leq 0.60$). The lithium manganese oxide of instant Claims 1 and 5 do not contain nickel. Furthermore, as disclosed in Manabu, for a lithium nickel manganese composite oxide where y is less than 0.4, a stable R-3m rhombohedral structure cannot be obtained, and for a value of y greater than 0.6, the safety of the secondary battery may be compromised. Therefore, y for such compounds is desirably in the range of 0.4-0.6. (Manabu, paragraph [0010]) The courts have held that "[i]f the proposed modification would render the prior art invention being modified unsatisfactorily for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon* 733 F. 2d 900, 221 USPQ 1125 (Fed. Cir. 1984). The courts have also held that '[i]f the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings

of the references are not sufficient to render the claims prima facie obvious.'" *In re Ratti* 270 F. 2d 810, 123 USPQ 349 (CCPA 1959). As stated above, the lithium manganese oxide of amended instant claim 1 does not contain nickel. Based on the teachings of Manabu, one of ordinary skill in the art would understand that amending Manabu by remove nickel would also remove advantageous properties of the resulting composition of Manabu. Manabu would in this way not achieve a stable R-3-m rhombohedral structure. Consequently, there is no teaching in Manabu that would lead one skilled in the art to so modify Manabu to remove nickel, and further, given the teachings of Manabu that too low a nickel content would not provide the required structure, to do so would not be expected to meet with a reasonable expectation for success.

Therefore for at least these reasons, Manabu and Hasegawa fail to teach all limitations of the instant claims, fail to provide a prompting that would lead one skilled in the art to modify the composition of Manabu by removing all nickel, and as a result would not provide a reasonable expectation that the composition would be successful based on the disclosure that the structure would change.

Thus claims 1 and 5 are non-obvious and thus patentable over Manabu and Hasegawa, alone or in combination. Claims 2-4 depend from claim 1, and claims 6-10 depend from claim 5, thus are also patentable for at least these reasons. Accordingly, reconsideration, withdrawal of the rejections of claims 1-10 under 35 U.S.C. § 103, and allowance of the instant claims are respectfully requested.

Conclusion

It is believed that the foregoing amendments and remarks fully comply with the Office Action and that the claims herein should now be allowable to Applicants. Accordingly, reconsideration and withdrawal of the objection(s) and rejection(s) and allowance of the case are respectfully requested.

Applicants hereby petition for any necessary extension of time required under 37 C.F.R. 1.136(a) or 1.136(b) which may be required for entry and consideration of the present Reply.

If there are any additional charges due with respect to this Amendment or otherwise, please charge them to Deposit Account No. 06-1130 maintained by Applicants' Attorneys.

Respectfully submitted,

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